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REMOVAL OF ENDOCRINE DISRUPTING COMPOUNDS FROM WASTEWATER. A COMPARISON BETWEEN A CONVENTIONAL ACTIVATED SLUDGE WITH TERTIARY TREATMENT AND MEMBRANE BIOREACTORS

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I. U. DEL AGUA Y LAS CIENCIAS AMBIENTALES

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INTRODUCTION

In recent years a number of emerging pollutants that can interfere the normal action of the endocrine system in both wildlife and human population at concentrations as low as 1 ng/L have been studied. These compounds, collectively called endocrine disrupting compounds (EDCs), include various members of distinct chemical groups such as synthetic estrogens, phenols, alkylphenols and phtalates.

MATERIALS AND METHODS

Compounds monitorized:
Dimethylphthalate (DMP), Diethylphtalate (DEP) 4-tert-octylphenol(4-t-OP), Nonylphenol (NP), 4-octylphenol (4-OP), di-n-butylphthalate (DBP), butyl benzilphthalate (BBP), bis-2-ethylheylphthalate (BEHP), Bisphenol A (BPA), di-n-octylphtalate (DOP), Estrone (E1), 17-α-Ethynilestradiol (EE2)

SAMPLING

Samples were taken weekly from October 2009 to January 2010 from the effluent of the primary settling (PS) tank, the tertiary treatment (TT) of the conventional activated sludge plant (CAS) and the outlet of the flat sheet (FS) and the hollow fibre (HF) membrane bioreactor plant (MBR).

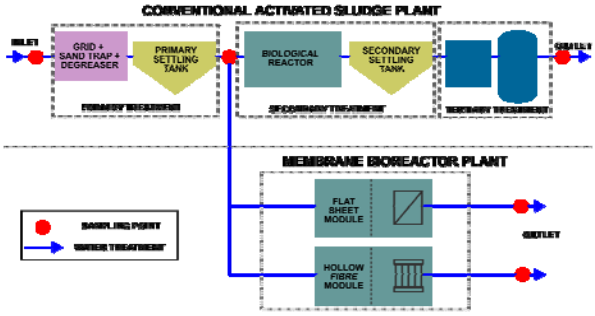

Figure 1. Wastewater treatment in CAS and MBR plant.

An analytical method for simultaneous EDC's determination in wastewater has been developed adapted from Tann et al. (2008) consisting on Stir bar sorptive extraction and Termal desorption coupled with a Gas Cromatography Mass Spectrometry. (SBSE-TDS-GC/MS).

Total organic carbon was measured to characterise influent and effluent of each treatment and is shown in Table 1.

Table 1. Total organic carbon (TOC) monitored after each sampling process.

	TOC, mg/L (Reduction, %)							
Week	1	2	3	4	5	6	7	8
PS	49	254	297	112	91	75	109	69
TT	11.4 (77)	9.8 (96)	12.8 (96)	9.7 (91)	23.7 (74)	10.8 (86)	14.0 (87)	10.6 (85)
FS	8.7 (82)	9.4 (96)	10.3 (97)	10.6 (91)	8.9 (90)	8.6 (89)	7.9 (93)	9.0 (87)
HF				8.5 (92)	5.7 (94)	7.6 (90)	7.1 (94)	8.0 (88)

RESULTS AND DISCUSSION

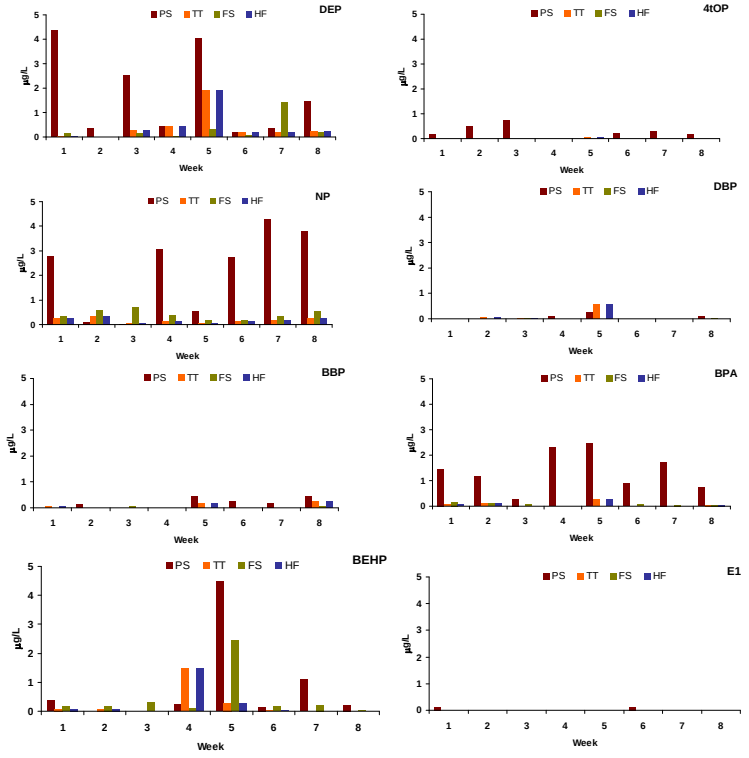

Figure 2. Average removal of EDCs in CAS and MBR plants.

Dissolved (µg/L) concentrations of EDCs in CAS and MBRs are shown in Figure 2.

Concentration of selected EDCs after the primary settling (PS) tank were ranged from nd (not detected) to 5 µg/L. Detection frequency for DEP and BPA were 100%, 4tOP, NP, BBP and BEHP amounted up to 50%, DBP and E1 detection frequency were below 50%. DMP, 4OP, DOP and EE2 were not detected after the PS during the monitoring period.

The major concentration levels were found in DEP, NP, BPA and BEHP ranging 2-5 µg/L. Comparable concentration levels were reported by other authors in WWTP influents ranged from 0.77 to 9.2 µg/L for DEP, 1.28-4.03 µg/L for NP, 0.72-2.4 µg/L for BPA 3.4-34 µg/L for BEHP (Clara et al., 2005 and 2010).

The measured concentration of EDCs in TT, FS and HF were notably lower than PS ranging nd-0.5 µg/L, except for some samples in DEP (week 5 for TT and HF, week 7 for FS) and DEHP (week 4 for TT and HF, week 5 for FS).

CONCLUSIONS

The removal of EDCs where studied in wastewater treatment systems: conventional treatment by activated sludge system connected with tertiary treatment and MBR with submerged membrane systems (flat and hollow fibre membranes).

Phthalates have a removal percentage over 60 %; E1 and 4tOP removal was around to 100 % while NP was between 65-85 % and E1 showed a removal higher than 92 %.

The results did not show significant variations as a function of treatment applied (CAS with TT or MBR).

REFERENCES

Clara M., Strenn B., Gans O., Martinez E., Kreuzinger N., Kroiss H. Removal of selected pharmaceuticals, fragances and endocrine disrupting compounds in a membrane bioreactor and conventional wastewater treatment plants. Water Research, 39. pp 4797-4807, 2005.

Tan B.L.L., Hawker D.W., Müller J.F., Tremblay L.A., Chapman H.F. Stir bar sorptive extraction and trace analysis of selected endocrine disruptors in water, biosolids and sludge samples by thermal desorption with gas chromatography-mass spectrometry. Water Research 42, pp. 404-412, 2008.

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